Technical difficulty of SXR diagnostics and reconstruction data

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In preparation of ITER operation many tokamaks have started equipping with metallic walls and tungsten divertor. The subsequently produced heavy impurities can trigger core radiative collapse, interact with Magneto-Hydro-Dynamics instabilities, affect core and edge confinement and cause fuel dilution. It is thus crucial to understand how they are transported if a sustainable H-mode is to be reached in ITER.

Plasma diagnostics based on broad-band emission of soft X rays (SXR) by the plasma are used on most fusion research devices and applied in general to study MagnetoHydroDynamic (MHD) phenomena. But SXR diagnostics provide also useful insights into impurities' spatial distribution and help analyse their transport [1]. Under reasonable hypothesis a poloidal SXR tomography can give a fast and sufficiently accurate description of an impurity's total density distribution in the plasma [2]. This approach hinges on the ability of the cooling factor of some impurities to be only weakly affected by transport coefficients.

But the quality of both measurement and tomographic inversion are crucial to get an accurate behaviour of impurity distribution. This talk focusses on the difficulties inherent to SXR measurement and tomographic reconstruction techniques. Solutions adopted concerning signal treatment including, preamplifiers, filtering and finally data storage which for long pulse machines like Tore Supra can become a critical issue, will be given. Description of the tomographic inversion technique of the SXR measurements developed for Tore Supra based on the minimum Fisher regularisation on a grid of square pixels will be described. Finally adaptation of this technique to WEST new tomographic system will discussed in details.

[1] M. Mattioli et al., *Nuclear fusion*, vol. 38, p. 1629, 1998.

[2] D. Vezinet et al., *Fus. Sci. Tech.* vol. 63, no. 1, pp. 9–19, 2013.